A 60-85% Efficient X- & K-Band 1KWatt Solid-State Power Amplifier using GaN-on-Diamond, Phase I

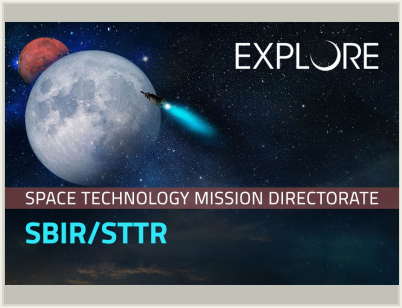
Completed Technology Project (2009 - 2009)

Project Introduction

This Phase-I SBIR proposal proposes for the first time ever, the use of a new class of materials - Gallium Nitride-on-diamond - in the manufacture of very high efficiency, solid-state Power Amplifier MMICs that will operate in X-band (8.4GHz), and Ka-band (26-38GHz). In this particular proposal, the first ever 80% efficient 8.4GHz and 34-38GHz GaN-on-Diamond FETs will be demonstrated, exhibiting a record 5-10 W/mm at record temperature levels. Arrays of these FETs will be used to form 60%+ efficient 150W-1KWatt Power Amplifiers (PA) MMICs in Phase-II. Polycrystalline free standing CVD diamond nature's most efficient thermal conductor enables nearly perfect heat extraction from a "hot" device (Thermal conductivities of GaAs, Si, and SiC are 35W/m/K, 150W/m/K and 390W/m/K respectively; diamond ranges from 1200-2000 W/m/K depending on quality). In the proposed scheme, the device's active epitaxial layers are removed from their original host substrate and transferred to a specially treated low-cost CVD diamond substrate using a proprietary low-cost manufacturable scheme. The active junction rests just 20-nm from diamond. The diamond technology proposed here may be applied to GaAs, SiC, SiGe, etc.

Anticipated Benefits

GaN-on-Diamond Power Amplifiers may be used for Base-stations (3G and WiMax). Also, GaN-on-Diamond wafers ay be used for blue/white LEDs (displays), and Laser Diodes (storage, DVD, litho). Group4 Labs shall manufacture 150W-1KW X-band, and Ka-band (26-38GHz) solid-state Power Amplifiers for use in NASA's Space-Space and Space-Earth RF equipment. Group4 Labs' partners and NASA contractors (Raytheon and Lockheed Marting) shall manufacture the space telecommunications systems (e.g. modules, satelites).



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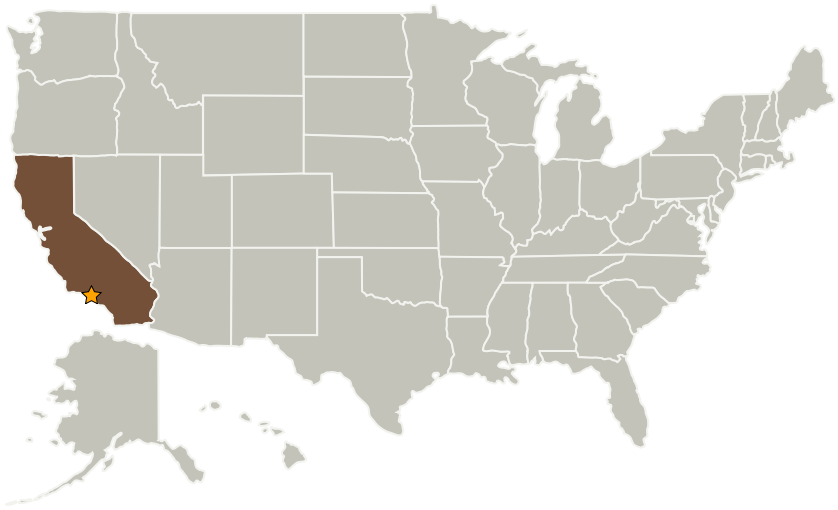
Completed Technology Project (2009 - 2009)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California
Group4 Labs, LLC	Supporting Organization	Industry	Menlo Park, California

Primary U.S. Work Locations
California

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Celestino Jun Rosca

Principal Investigator:

Felix Ejeckam

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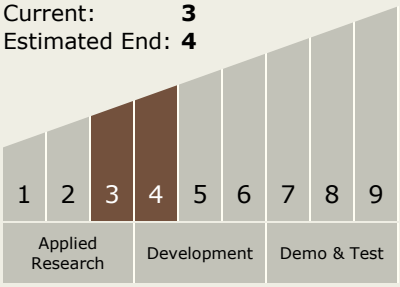
Completed Technology Project (2009 - 2009)

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **4**



Technology Areas

Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  - TX05.2 Radio Frequency
    - TX05.2.2 Power-Efficiency